

# **Micro-scale Heterogeneity of Organo-mineral Soil Colloids Studied by X-ray Microscopy and Micro-spectroscopy**

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**Introduction:** Soil organic matter (SOM) is an important sorbent for plant nutrients and for inorganic and organic pollutants. This property is due to its high surface area, the sorption of ions at charged, hydrophilic functional groups and the sorption of nonpolar, organic compounds by hydrophobic surface sites. Furthermore, mobile organo-mineral soil colloids may transport otherwise relatively immobile, strongly sorbing contaminants in soils, groundwater aquifers or fractured rock. These colloids often consist of clay minerals and hydroxides of Fe, Al and Mn, coated or embedded in natural organic matter. The pollutants prone to transport by these carriers are radionuclides, heavy metals and a wide range of organics with either hydrophobic or hydrophilic behavior.

**Methods and Materials:** Colloidal particles of 2 different topsoils were prepared by suspending the whole soil in water and separating the fraction < 2 µm by gravimetric sedimentation. Humic and fulvic acids from the same 2 topsoils were isolated as recommended by the International Humic Substances Society and purified by dialysis. Films of both types of samples were prepared by drying a 1 µL droplet of aqueous suspension on a silicon nitride window with 100 nm thickness. Spectra were recorded through these films and the silicon nitride window from 280 to 290 eV and 290 to 315 eV in steps of 0.5 eV and 0.1 eV, respectively.

**Results:** Depending on their composition, the NEXAFS spectra of the investigated compounds showed bands indicative of aromatic, phenolic and carboxyl C-groups. The positions of these bands correspond to transition energies of Carbon 1s electrons of particular chemical functional groups, in this case of aromatic carbon at 285 eV, phenolic carbon at 287 eV and carboxylic carbon groups at 288.5 eV. Currently, the spectra are being analyzed to relate the quantitative features derived from NEXAFS to the information obtained by CP-MAS <sup>13</sup>C-NMR.

**Conclusions:** As can be seen, such C-NEXAFS spectra are indicative of the local bonding environment of carbon and can provide vital information about the chemical heterogeneities of SOM-particles with high spatial resolution. The investigation of such micro-heterogeneities has significant consequences for the partitioning of organic and inorganic solutes, thus reveal information on the fate of dissolved nutrients and pollutants as well as on the transport of nutrients and pollutants bound to mobile colloids.

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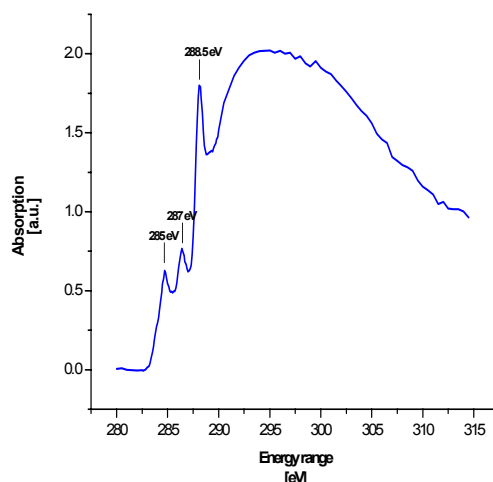


Figure 1. NEXAFS spectra of a SOM-particle